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Environmental Effects of Dredging Technical Notes

LONG-TERM BIOLOGICAL STUDIES IN BOTTOMLAND HARDWOOD WETLANDS, CACHE RIVER, ARKANSAS

PURPOSE: This technical note provides an overview of vegetation, fish, and wildlife research studies underway in bottomland hardwood wetlands along the Cache River in Arkansas. The objectives of these studies are to obtain quantitative data to improve the technical accuracy of assessing biological functions and values of bottomland hardwoods, and to improve fish and wildlife habitat models in the Wetland Evaluation Technique (Adamus et al. 1987).

BACKGROUND: A survey of US Army Corps of Engineers district and division personnel was conducted in 1982 (Forsythe, Clairain, and Smith 1983) to determine which wetland types should receive the highest priority for research funding. Bottomland hardwood wetlands in the Lower Mississippi River Valley were assigned the highest priority for research. Consequently, a comprehensive study examining physical, chemical, and biological functions of bottomland hardwood wetlands was initiated in 1985 and will continue through 1989.

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Introduction

A wetland evaluation technique developed for the Federal Highway Administration (Adamus 1983) was revised by the US Army Engineer Waterways Experiment Station (WES) and published as an operational draft (Adamus et al. 1987). The Wetlands Evaluation Technique (WET) provides an assessment of 11 different functions. This operational draft will be revised and refined during the next several years to improve its technical accuracy. One major revision planned during this period is improving the technical accuracy by developing regionalized wetland evaluation models. Research initiated by WES in bottomland hardwood wetlands will provide information necessary to develop these regional

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models for this wetland type. This technical note describes biological research underway in bottomland hardwood wetlands along the Cache River in Arkansas.

Site Description

The Black Swamp Wildlife Management Area (BSWMA) in east central Arkansas was selected for comprehensive study after a detailed evaluation of sites throughout the southeastern United States. The BSWMA consists of approximately 80 km^2 of floodplain and adjacent uplands along the Cache River in Woodruff County, Arkansas (Figure 1). The Cache River has a watershed of about 2,875 km^2 upstream of the study area, and local stream gage data are available from 1937 to the present. The Cache River Basin floodplain supports one of the largest remaining tracts of bottomland hardwood and alluvial swamp forests in the Lower Mississippi River Alluvial Plain (Cache River Basin Task Force 1978). The BSWMA has been reported as one of the most ecologically significant areas in the Cache River system (US Army Corps of Engineers 1974).

Plant communities in bottomland hardwoods have been divided into six different zones, based on species composition, soils, and hydrology (Clark and Benforado 1981). Plant zonation is evidenced at the study area. Zone 2, dominated by cypress-tupelo (*Taxodium distichum-Nyssa aquatica*), is the most prevalent in the study area. Plant communities in Zone 2 are fairly homogeneous with very little understory diversity. Zones 3 and above tend to exhibit greater diversity. Water hickory (*Carya aquatica*) and overcup oak (*Quercus lyrata*) are prevalent in the overstory of Zone 3, and common buttonbush (*Cephalanthus occidentalis*) and English dogwood (*Cornus foemina*) are common in the understory. Evidence of logging within the last 25 to 30 years (primarily high-graded timber) can be seen in some areas, but overall little disturbance is observed at the site.

Lands bordering the forested areas are primarily in private ownership and agricultural production. Harvesting of row crops, such as cotton and soybeans, results in exposed soils subject to erosion and sediment transport into the wetland via overland flows and several small channels.

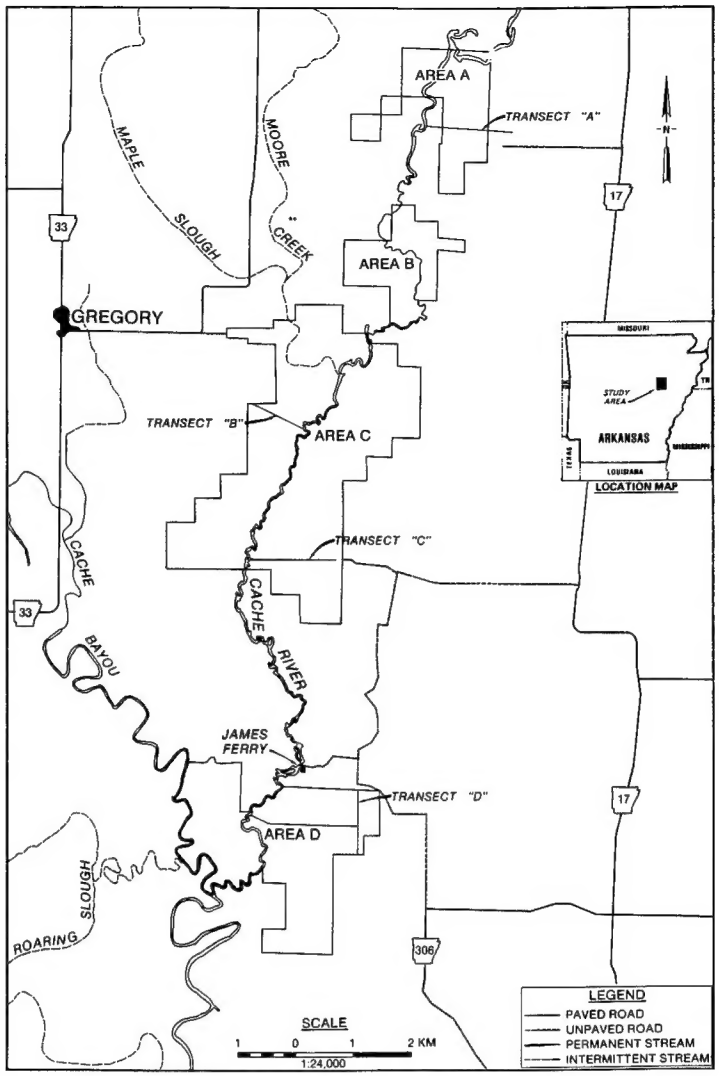

Figure 1. Sample transect locations, Cache River, Arkansas

Biological Studies

Biological studies in the BSWMA were divided into three interrelated components: vegetation, fish, and wildlife. Research efforts during 1987 were directed toward characterizing the site and developing a data base of biological information. This data base includes information on the physical features of the site (e.g., roads and streams), land use, elevations, soils, hydrology, and vegetation types. Research designs will be refined in 1988 and 1989 based on these characterization studies. The study design and preliminary results of the characterization studies are discussed below.

In the spring of 1986, 1:12,000-scale color infrared aerial photography was taken of the site to aid in establishing vegetation transect locations, type mapping vegetation communities (Society of American Foresters 1980), and determining adjacent land use. Based on preliminary type mapping and field reconnaissance, four areas along the Cache River were examined for potential intensive vegetation sampling (Figure 1). Sample transects were subsequently located within three of the areas. Transect directions and locations were established to traverse the hydrologic gradient from the Cache River upslope to the highest vegetated ground and to cross as many vegetative zones as possible. Within each transect at least two vegetation zones are represented with Zones 2, 3, and 4 represented throughout the project area. Most of Zone 6 has been cleared and converted to agricultural production.

During the fall of 1986, temporary benchmarks were established at the highest point along each transect. A total of 171 0.04-ha sampling plots were located along the transects at 60-m intervals. Plot elevations were subsequently determined to assess flood duration at each vegetation plot. Parallel transects were established at transects A and C to provide additional data for wildlife studies.

Vegetation

Vegetation is not a wetland function or value and, therefore, is not specifically assessed by WET. However, wetland vegetation is considered when fish and wildlife habitat, water quality, hydrology, and other functions are assessed by WET. Vegetation sampling was initiated during the summer and fall of 1987 along the four transects. Within each 0.04-ha plot, trees greater than 6.6 cm diameter at breast height (dbh) were identified by species and the diameter breast height measured. Saplings (2.5 to 6.6 cm dbh), shrubs, and woody vines were also identified by species and tallied in two 0.004-ha circular subplots randomly located within the larger 0.04-ha plot. Woody seedlings (<2.5 cm dbh) were identified and tallied in two 0.0004-ha subplots nested within the 0.004-ha subplots. Absolute and relative density of seedlings, saplings, woody vines, and trees are being calculated for each plot and subplot. Absolute and relative basal area of trees are also being calculated for each plot. The Importance Value (IV) 200 (relative density + relative basal area) (Curtis 1959) is being calculated for trees at each plot. These data will be placed into separate matrices for tree basal area, density, and IV 200 as well as matrices for sapling, seedling, and woody vine relative densities.

Matrices will be used as input to the Two-Way Indicator Species Analysis (TWINSPAN), a classification algorithm that objectively classifies plots into community types (Hill 1979). The original forest cover types will be evaluated and revised using the community types identified by TWINSPAN. Forest cover types will be characterized in terms of species composition; dominance and density of trees; density of saplings, woody seedlings, shrubs, and woody vines; and soil characteristics.

Fish habitat

WET evaluates freshwater fishery habitat according to general aquatic diversity/abundance, four freshwater fish species groups, and 47 species of freshwater fish. The overall purpose of the fish habitat study is to test and refine the fish habitat models in WET. Specifically, fisheries studies will: (1) assess the use of bottomland hardwood forests by fish found within nearby watercourses; (2) relate the abundance and distribution of fish to variations in measured physical, chemical, and biological attributes (such as vegetation composition and distribution) of the wetland; (3) construct a testable model to evaluate use of bottomland hardwoods by fish; and (4) incorporate the findings of this field study into bottomland hardwood evaluation models.

The sampling protocol for fish studies in 1988 is based on data needs for WET, results of several site visits, and two preliminary sampling trips for adult fish made in June and July 1987. Both larval fishes and adults will be collected during 1988. Only transects B and C (Figure 1) of the four study areas will be sampled for fish since these areas were found to represent all the physical features characteristic of the BSWMA. Within each area, three habitats will be sampled. The cypress-tupelo zone (Zone 2) will be sampled as a homogeneous unit. Zone 3 consists of two distinctly different types of microhabitats: areas with little understory vegetation and areas with dense understory growth. These microhabitats will be sampled separately so that any variation between them can be distinguished. Actual sampling began in March. Sampling will occur at approximately 3-week intervals, through late June or early July, resulting in six potential sampling trips.

Sixty larval fish samples will be collected within the forested wetland during each sampling trip. Ten samples will also be obtained from the Cache River above and below the study area. Larval fish samples will be collected using a diaphragm pump and light traps. Adult fish will be sampled at 35 locations, including the Cache River, using a boat-mounted electroshocker.

A subsample of adult fish will be examined to assess stage of maturity and to indicate species potentially spawning in the wetland. Samples taken with each type of sampling gear will be randomly allocated within each transect area and vegetation zone.

During fish sample collections, several physical-chemical parameters will also be measured. Current velocity, depth, and amount and general type of vegetation will be recorded at each fish sampling station. In addition, water temperature, dissolved oxygen, turbidity, pH, and conductivity will be collected at two sampling stations within each habitat type.

Fish samples will be analyzed separately for larval and adult species. Data from sampling will be separated according to sampling method, so that the effects of sampling methods on the samples obtained can be analyzed. Multiple regression techniques will be used to assess the relationship of fish density and species composition to physical-chemical variables measured for the sampling areas. Physical and chemical variables used will include both those measured during fish collections and those collected during other studies being conducted on the BSWMA.

Wildlife habitat

WET contains procedures for assessing the probability that a wetland supports a high density or diversity of wetland-dependent bird species. It also assesses 14 waterfowl species groups and 109 individual wetland-dependent birds. Other segments of the vertebrate community, such as mammals or reptiles, are not considered in the evaluation.

The general objectives of the wildlife habitat studies are to expand the scope of the wildlife component of WET to include other vertebrate groups in addition to birds, improve the structure and flow of the method, and develop and incorporate modifications to improve the accuracy of results.

Wildlife habitat has been examined more thoroughly and has a broader literature base upon which to develop evaluation models than most other wetland functions. Therefore, early emphasis of the wildlife studies has been and will continue to be directed toward detailed reviews and revision of WET models. Many wildlife models have also been developed for use in the Habitat Evaluation Procedures (US Fish and Wildlife Service 1980) and will be reviewed to determine applicability to WET.

Baseline wildlife information is being collected from the study area during the spring and summer of 1988. Samples are being collected from plots

along transects A and C (Figure 1). Characteristics of the sample plots, such as canopy cover of the overstory, species composition and density of shrubs, herbaceous cover, and abundance of downfall and litter, will be measured on the 0.04-ha plots used in the vegetation studies. These data, along with information on flooding regime, juxtaposition of cover types, and other topographic features, will be used to generate WET ratings for wildlife for each of the sites on the study area.

The study sites will be surveyed in the spring to determine bird species diversity. Time-area counts will be done simultaneously to estimate use of the sites by squirrels. Tracks and other indicators of animal use will be noted during field investigations. Trapping will be conducted to estimate the use of the sites by small mammals, reptiles, and amphibians. These data, along with available literature, will guide the model modification process.

To supplement the waterfowl models currently in WET, several other species or species groups will be selected and models developed. These models will allow users the option of making a more detailed assessment.

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